EMBO reports

analysis

Private ownership of public heritage

Interest in the archives of leading molecular biologists is on the rise, as are concerns about these valuable resources ending up in private hands

In 2003, the world celebrated the fiftieth anniversary of the elucidation of the structure of DNA and, thus, the birth of molecular biology. As this period is now a part of human history, original documents from the founders of molecular biology are becoming increasingly important to scholars, and are being harshly fought over by public libraries and private collectors. Private correspondence, laboratory notebooks, draft manuscripts, meeting and travel notes, and photographs all make up the primary documentation that allows historians to understand how theories and discoveries developed, while revealing details of the complex personalities behind the achievements and their roles in biological research. Arguments over such documents raise the question of whether this part of the common cultural heritage, and, more generally, any historical scientific treasure, should be retained in its country of origin and made accessible to the public, while restricting private ownership.

Fig 1 | Vittorio Luzzati, photographed in 2003 with one of his pictures of Rosalind Franklin on the computer screen. Reproduced with permission from Philippe Plailly/Eurelios, Montreuil, France.

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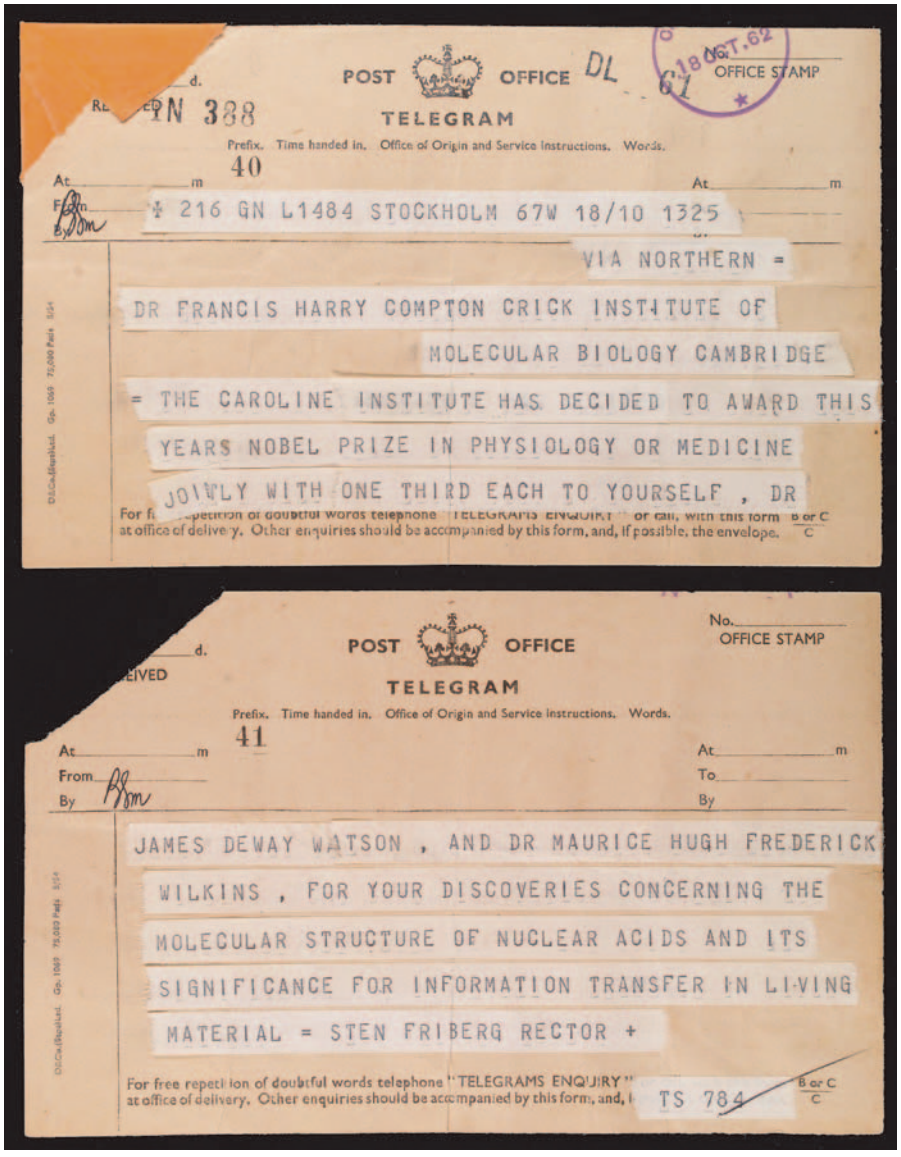
Many of these questions were triggered by the controversy surrounding the so-called Norman Collection, a huge archive of papers from the main protagonists of the 'classic period' of molecular biology, including Aaron Klug, Max Perutz, Rosalind Franklin, Francis Crick, James Watson, Rollin Hotchkiss, Sven Furberg, Sydney Brenner, Max Delbrück and Maurice Wilkins. Rare-book dealer Jeremy Norman in California put together this scientific trove with the help of Al Seckel, a neuroscientist working at the California Institute of Technology in Pasadena, USA, who personally contacted scientists in order to buy their professional archives. In a few years, and with some US$1.5 million, Seckel and Norman amassed an immense amount of material, including rarities such as Wilkin's personal copy of Watson's controversial draft book *Honest Jim*, later published in a revised form under the title *The Double Helix*.

Perhaps to reassure science historians who were worried about accessing the papers, Norman said he would not sell the collection, but instead would donate it to the University of California at Berkeley, USA (Dalton, 2001). Shortly thereafter, however, Norman instructed Christie's auction house in New York (NY, USA) to sell his archive piece by piece. At that point, it also came to light that many of the scientists who had sold their papers to Seckel had done so under an agreement that the archive would be kept together in a single, publicly accessible collection, and that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JAMES DEWAY WATSON , AND DR MAURICE HUGH FREDERICK
WILKINS , FOR YOUR DISCOVERIES CONCERNING THE
MOLECULAR STRUCTURE OF NUCLEAR ACIDS AND ITS
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MATERIAL = STEN FRIBERG RECTOR +
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Fig 2 | A two-part Post Office telegram (18 October 1962) to Francis Crick from Sten Friberg, Rector of the Karolinska Institutet, Stockholm, Sweden, informing him of the award of the 1962 Nobel Prize in Physiology or Medicine to Crick, James Watson and Maurice Wilkins for "discoveries concerning the molecular structure of nuclear acids and its significance for information transfer in living material". Reproduced with permission from the Wellcome Library, London, UK.

Seckel himself was endorsing that view (Dalton, 2003). A subsequent intense crossfire of lawsuits forced Christie's to cancel the auction, which had been scheduled for April 2003, and prompted Norman to seek a buyer for an *en bloc* sale.

Other episodes also cast some doubt on the intentions of Norman and Seckel. Vittorio Luzzati, a crystallographer at the Centre for Molecular Genetics in Gif-sur-Yvette near Paris, France, received a visit from Seckel at the end of March 2000. Luzzati collaborated with Rosalind Franklin during the period when she worked in France (1947–1950), and the two remained close friends. Seckel, who was introduced to Luzzati by Klug, inspected the Franklin-related material that Luzzati owned and asked him to donate it to the 'Norman Foundation'. Luzzati accepted and gave Seckel some reprints of old articles, a handwritten letter from Franklin discussing scientific issues, and, most importantly, an entire series of original photographs of Franklin that Luzzati had taken during holidays with her and other colleagues in 1950–1951 in Central Italy and the Alps (Fig 1). As the negatives of these photographs no longer exist, Seckel agreed to make copies of the prints and return the originals within a couple of days—according to Luzzati, Seckel's wife, a photographer, was in Paris with him and would take care of this task—together with photocopies of the Franklin letter. So far, Luzzati says that he has received neither the original photographs nor the photocopies, despite Norman claiming to have returned them in 2001 (Dalton, 2001). Luzzati explained that, after tense correspondence with Seckel and Norman, and his pressing requests for the original prints, the only things Norman ever sent were low-quality copies, for which Luzzati was even invoiced. "It was like one of those photographic albums grandpas give their grandchildren as a present," Luzzati recalled.

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The situation eventually settled down in August 2005, when Craig Venter announced the acquisition—for an undisclosed sum—of the Jeremy Norman Molecular Biology Archive and its relocation to the Venter Institute in Rockville (MD, USA). "As part of our public education initiative at the Venter Institute, we look forward to sharing this tremendous compilation of molecular biology history with others," Venter commented in a press release (J. Craig Venter Institute, 2005). "In the future, we hope to complement the collection with additional key scientific documents." Venter plans to add his own papers and those of his colleague Hamilton Smith (Wade, 2005). Now, Luzzati hopes that he will finally be able to get the Franklin photographs back, leaving copies to Venter. If the originals return home, Luzzati is ready to entrust them to a public institution. "I believe it appropriate that highly valuable scientific documents should be preserved by institutions, where researchers and erudites can freely access the records," he said.

The Norman case has raised many concerns and posed problems about how to handle historical scientific material. In the first place, it is surprising that many influential scientists, who shaped an entire discipline from its beginning and who should be well aware of the historical importance of their work, preferred to offer their papers on the market to the highest bidder, instead of donating them to their own institutions or public libraries. "I strongly support the view that scientific papers should be considered part of the historical heritage, and should be preserved and made accessible to scholars," said Soraya de Chadarevian, a historian of twentieth-century life sciences at the University of Cambridge, UK, and a member of several committees devoted to the preservation of scientific papers. "Norman's acquisition and sale of molecular-biology papers has complicated this process, since other scientists in the field now also expect to fetch prices for their papers that most archives are neither able nor prepared to pay," she added. "Norman's activity has served individual pockets, but, at least so far, not the accessibility of the papers."

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However, are those who traded their bit of history the only ones to blame? What about public institutions? Is the lack of resources the only reason that they did not try to acquire this material? In other words, how is it possible that Norman and Seckel could assemble their collection simply by asking people to sell their documents, all without any interference or competition from archival organizations or science museums? "An important fact that was neglected … concerns the very positive service that I served in locating innumerable lost historical documents, which shed a tremendous amount of light on various issues. Furthermore, in many cases, scientists were about to dispose of their archives because no one was interested in them…" Seckel wrote in response to criticisms of his conduct (Seckel, 2003). "Where were the archivists then? It is too easy to be the critic after the fact, rather than be a visionary at the beginning. Libraries, archivists, and established institutions are not necessarily known for their speed at making things happen," he noted. Norman had previously expressed similar feelings (Dalton, 2001).

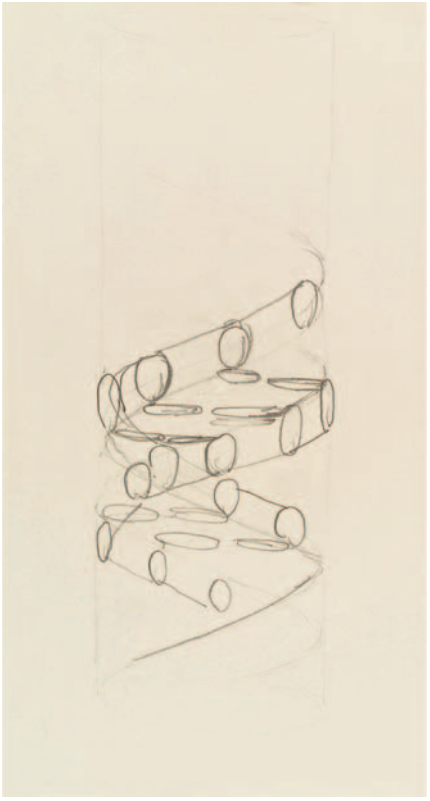

Fig 3 | Pencil sketch of the DNA double helix by Francis Crick, dated 1953. It shows a right-handed helix and the nucleotides of the two anti-parallel strands. Reproduced with permission from the Wellcome Library, London, UK.

"I do think it is highly desirable that collections of documents such as the Norman Collection should be available to the public, especially including the scientific community. However, I am not sure there is an ideal way to achieve that end," said Richard Roberts, who received the 1993 Nobel Prize in Physiology or Medicine together with Phillip Sharp, for their discoveries of split genes. "While some scientists are prepared to donate such collections, many would prefer to get some cash return for them. That is not something that most public institutions can provide very readily," added Roberts, now at New England Biolabs (Ipswich, MA, USA). To prevent the Norman papers from being dispersed, Roberts, along with prominent scientists Norton Zinder, Jim Hudson and Klug, attempted to raise money and purchase the collection. The idea was to donate the collection to Cold Spring Harbor Laboratory (MA, USA), where Watson was ready to host them in a new building together with his own papers. However, their call for funds failed, and Venter, one of those approached by Roberts and colleagues, eventually stepped in to finish the job. "I think if the public institutions want to maintain archives, they need to be proactive in contacting the individuals with the materials at as early a stage as possible and work out a deal whereby they can be guaranteed the collection at some point," said Roberts. "It seems to me this should be doable fairly easily."

Indeed, some institutions have done just this. At the end of 2001, the Wellcome Trust (London, UK) acquired Crick's scientific archive, covering the glowing period of the early 1950s, and all his subsequent work in molecular biology and neuroscience (Figs 2,3). The Wellcome Trust and the Heritage Lottery Fund each contributed UK£904,000 for the purchase, slightly less than Crick was offered from Seckel on behalf of a private collector who purportedly would have donated the papers to the California Institute of Technology, apparently leaving Norman out of the game (Wade, 2005). Before selling his papers, Crick had arranged to give them to the University of California at San Diego (Morgan, 2001). The Wellcome–Lottery coalition has thus ensured that Crick's landmark papers remain in his home country, open to the public. The cataloguing of the thousands of documents, currently hosted in the Wellcome Library in London, UK, is now being completed, and batches of papers have been released for study at regular intervals.

Similarly, the National Cataloguing Unit for the Archives of Contemporary Scientists (NCUACS; www.bath.ac.uk/ncuacs), based

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NOT JUST PAPER

Understandably, historians who are interested in molecular biology's past are eager to investigate the Norman archive and similar collections. However, other types of physical artefact can offer important glimpses into research and the connections between researchers. In some cases, the artefacts are themselves a significant piece of history and carry a strong iconographic charge. "The iconography of molecular biology hinges on the representational devices used in the laboratory, iconographic conventions, and the use and reception of iconographic representation in publications, lectures, exhibitions, and so forth," said Soraya de Chadarevian, a historian of twentieth-century life sciences at the University of Cambridge, UK. Think, for example, of James Watson and Francis Crick's first model of DNA. Built at the Cavendish Laboratory in Cambridge, UK, in 1953, and then shown between its creators in a famous photograph taken by Antony Barrington Brown (de Chadarevian, 2003a), the model soon became neglected and fell to pieces. Twenty years later, explained de Chadarevian in her reconstruction of the model's fate, "the value attached to the original incarnation of the double helix had changed substantially," and "the spidery model of DNA has become the ultimate icon of twentieth-century life sciences" (de Chadarevian, 2003b). The historic status of the model was fully recognized when the Science Museum in London, UK, commissioned a replica, which includes some of the original base plates used by Crick and Watson (Fig 4). "The Science Museum does consider the history of molecular biology an important part of the history of science," said Robert Bud, the museum's principal curator of medicine and curator of bioscience. "We represent developments important for understanding both the present and the future, as well as the past, and seek out interesting artefacts that will inspire thought and reflection as well as provide information." Meanwhile, pieces supposedly belonging to the original model have appeared at auction (de Chadarevian, 2003b). "Molecular models—first physical ones, now mainly *in silico*—have played a crucial role in structural approaches to the field. They serve both as research tools as well as for the public presentation of the science," said de Chadarevian. "What I think is important to realize is that there is two-way traffic between iconographic representations in the lab and the wider culture."

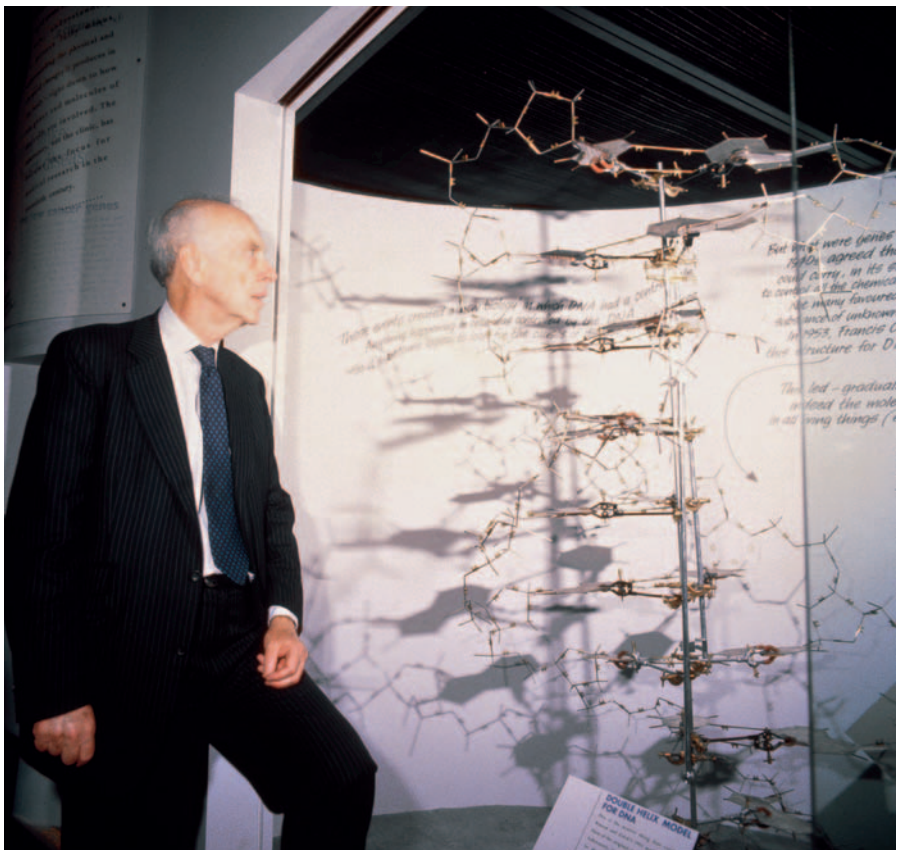

Fig 4 | James Dewey Watson with a replica of his model of the DNA molecule, 9 June 1994. The model contains some of the actual metal plates used by Watson and Francis Crick to determine the molecular structure of DNA in 1953, and is housed at the Science Museum, London, UK. Reproduced with permission from the Science Museum/Science and Society Picture Library, London, UK.

in Bath, UK, established in 1973 to "locate, sort, index and catalogue the manuscript papers of distinguished contemporary British scientists and engineers", actively pursues historical documents. The NCUACS is not an archive, but instead processes the collections donated by scientists or their families and places them in public repositories. To encourage donations and minimize losses of potentially important documents, the unit has produced a guide, entitled *Preserving Scientific Source Materials*, for owners of scientific archives. According to its Director, Peter Harper, the NCUACS has processed some 268 archives of British scientists across all disciplines. On the other side of the Atlantic, the US National Library of Medicine runs its Profiles in Science website, which is a digital, freely accessible collection of the archives of leaders in biomedical research and public health (http://profiles.nlm.nih.gov). Through its gateway, it is possible to browse selected papers from outstanding scientists, such as Oswald Theodore Avery and Linus Pauling.

"It should be remembered that, despite the Norman affair and the purchase of the Crick papers by the Wellcome Library, significant archives in molecular biology have been given and continue to be given to public repositories by scientists and their families," said Harper, who mentioned the archives of Sir John Kendrew (donated to the Bodleian Library, Oxford University, UK), Martin Pollock (donated to Edinburgh University Library, UK) and Cesar Milstein (donated to the Churchill Archives Centre, Cambridge University, UK). Many other private citizens and institutions are determined to collect, and make public, historical scientific documents. In 2004, philanthropists Gordon and Betty Moore donated the Neville Library to the Chemical Heritage Foundation (Philadelphia, PA, USA); this resource is considered to be the most important collection of chemical texts in the world, boasting an impressive series of masterpieces from the late 1400s to the early 1900s (Chemical Heritage Foundation, 2004). In March 2006, the Royal Society (London, UK) successfully blocked the sale of a seventeenth-century manuscript by the physicist Robert Hooke, containing the minutes of meetings he took as the Society's secretary. The unique text—said to have been taken

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from the Society's archives some 300 years ago and discovered in 2005 in a private house—was about to be auctioned when the Society and the vendors reached an agreement for a UK£1 million transaction. "We are keen that as wide an audience as possible, including scholars and the general public, should now be able to appreciate these documents," commented the Royal Society's President, Lord Rees of Ludlow, in a press release (Royal Society, 2006).

The moral of the story is that a general lack of awareness and sense of history has put at risk irreplaceable artefacts from a key scientific era. Scientific institutions, with a few remarkable exceptions, had little perception of science history, thus leaving the past of molecular biology unattended. At the same time, private collectors, book dealers and—worse—scientists ignored the public significance of the documents they were trading. "It is hoped that better awareness, stricter rules and more incentives [to institutions] will help achieve [a situation in which] scientific papers do not end up in the hands of private collectors but are deposited in established archives where they are accessible for historical research," de Chadarevian said. "The advice of the NCUACS would be that archives should find a permanent home at the institution with which the scientist was principally associated, subject of course to that institution's ability to provide professional curation and public access," confirmed Harper, adding that it must be genuine public access, not just for a handful of privileged researchers. He also expressed reservations about digitalization as a solution to problems associated with private ownership. "What guarantees are there of the authenticity of the digital record? Does a digital record in all cases replace the need to consult an original paper record?" Harper asked. At a minimum, scientists and historians can find some comfort in the recent sale of molecular biology papers, as it might prove to be an instructive lesson that inspires future efforts in the protection of our scientific heritage.

REFERENCES

Chemical Heritage Foundation (2004) Chemical Heritage Foundation receives rare early texts valued in excess of $10 million. Press release, 19 Apr. www.chemheritage.org

Dalton R (2001) The history man. *Nature* **411:** 732–733

Dalton R (2003) Fury at plan to split historic biology archive. *Nature* **421:** 564

de Chadarevian S (2003a) The making of an icon. *Science* **300:** 255–257

de Chadarevian S (2003b) Relics, replicas and commemorations. *Endeavour* **27:** 75–79

J. Craig Venter Institute (2005) Venter Institute announces acquisition of the Norman Collection: the history of molecular biology. Press release, 10 Aug. www.venterinstitute.org

Morgan N (2001) Francis Crick's papers helped by British Lottery. *San Diego Union-Tribune*, 12 Dec. www.signonsandiego.com

Royal Society (2006) Royal Society agrees return of Hooke folio. Press release, 28 Mar. www.royalsoc.ac.uk

Seckel A (2003) Response to: 'Molecular Biology: the issues surrounding the purchase of the archives of leading molecular biologists by an American collector'. www.bath.ac.uk/ncuacs/FP_Seckel.htm

Wade N (2005) Picassos? Warhols? No, this multimillion-dollar collection stars the science of DNA. *The New York Times*, 10 Aug, pA13

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Science cannot be left to the market alone

Meshing basic research with fiscal competitiveness is the key to economic success

Most leading industrialized nations, and an increasing number of developing countries, are realigning their publicly funded research more closely with the perceived demands of economic competitiveness and sustainable growth. The USA recently announced a substantial increase in its funding for physical sciences, and last year the European Union (EU) created the European Research Council (ERC) with a commitment to support only high-quality research across all sciences. India and China are increasing their investments in basic research, to catch up with Europe and North America scientifically as well as economically. Meanwhile, smaller nations are homing in on specific sectors in both basic and applied research, such as pharmaceuticals and nanotechnology, rather than spreading their limited resources thinly across the whole scientific spectrum.

The fact that research, technological progress and economic growth are closely linked is beyond dispute; however, there is still debate over which strategy is best suited to deploy finite resources and to stimulate technology transfer. A useful starting point is the observation that major 'disruptive' inventions, which change the course of an industry or the world as a whole, are almost always based on results from basic or fundamental research, according to Jörn Erselius, Managing Director of Garching Innovation (Munich, Germany), which organizes technology transfer from the Max Planck Institutes to businesses in Germany. "Examples [of major inventions] include monoclonal antibodies, PCR [polymerase chain reaction] and RNA interference," he said. These emerged from fundamental research and became important platform technologies for the life sciences. Surveys during the past two decades support Erselius' argument—for example, one study showed that 44% of innovative pharmaceutical products were derived from basic research (Mansfield, 1995).

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